

Delaware Statewide Forest Assessment Summary

January 15, 2010

Issues, Threats, and Opportunities

The DFS used two processes to identify the highest priority issues, threats, and opportunities for Delaware's forests. First, the DFS completed a comprehensive five-year strategic plan in 2008 through a facilitated process with forty participants representing a variety of stakeholders, including other public (state, federal, local) agencies, landowners, nongovernmental organizations, consultant foresters, forest industry, and recreationists. Through this effort, the stakeholders identified the critical issues facing Delaware's forests and then goals and objectives for the DFS to address in the next five years (2009-2013).

Second, Delaware's Forest Stewardship Committee participated in a facilitated process in 2009 to identify issues, threats, and opportunities facing our state's forests. The committee started with the issues identified during the strategic planning process, added any additional issues, and then specified threats and opportunities. The result was very similar to the outcomes of the strategic planning process.

Lastly, once the issues, threats, and opportunities were drafted, the DFS shared them with other stakeholders through individual visits and on the Internet to determine if this list was appropriate or if changes were necessary. Based on this input, the final list presented below was completed. Appendix [insert] includes a brief review of the processes and the complete list of organizations involved in this process.

a) Issues

Issue 1: The public must understand the importance of forests and forest management

While most citizens appreciate forests, most do not understand the wide range and depth of benefits our forests provide. Furthermore, many Delawareans do not understand that forest conservation and sustainable forests require public investment, both financial and technical assistance. Credible, current, easy-to-understand information and ongoing education – both student and adult – are needed for the general public to understand the intricacies of forest management and the techniques and practices necessary to achieve the goals of management. Often sound management techniques are not aesthetically pleasing and this issue must be addressed in forest management education.

Issue 2: Landowners must have diverse, stable forest markets.

A stable, robust and diverse market for forest products, not only timber but also other potential markets, such as carbon and bio-energy, is necessary to help achieve sustainable forest management. Landowners must have the ability to generate income from their forestland; otherwise, they are much more likely to convert their forestland to other uses, such as development. This is particularly evident in Delaware as proposed developments from 2002 – 2009 have included approximately 16,000 acres of forestland – six percent of our remaining unprotected forests. This demand for new homes, coupled with the recent downturn in timber prices, is increasing the pressure on forest landowners to consider converting their forests to other land uses.

Furthermore, Delaware needs a diverse forest market, one that has traditional industries (sawtimber and pulpwood) and emerging markets – such as bio-energy, carbon, and other ecosystem services. A robust forest market should also provide demand for all types of timber – not just the high quality species and stems – thereby helping landowners to sustainably manage their forests. Currently, there is an overabundance of low quality hardwood in Delaware; this lack of market has contributed to the proliferation of low-valued red maple and gum forests because these species are left during most timber harvests. Developing markets for these species would help foresters and landowners establish a better mix of tree species, both for wood production and wildlife habitat.

Markets for non-wood products are also important. Currently hunting leases are the primary non-wood market for forest landowners; however, emerging markets are on the horizon such as carbon credits and other ecosystem services. Establishing state and regional policies that include forests and reward forest management is vital to developing new markets for landowners. Furthermore, niche markets can also benefit landowners, such as Shitake mushroom production and even agri-tourism. Instituting policies that foster a diverse and robust forest market is necessary to retaining forestland, particularly privately owned forests, and sustainably managing them for the long-term.

Issue 3: Delaware’s forests are increasingly fragmented, parcelized, and affected by invasive species.

Delaware has more forestland than it did a century ago; however, Delaware is once again losing forests – primarily to development. From 2002 through 2009, 16,000 acres were included in proposed developments. While not all of these projects will occur, it is very likely that most of these forests will either disappear or will be fragmented so that they no longer provide many of the services that we now enjoy. With increased population also comes more landowners and smaller forest ownerships. The average forest ownership is less than 10 acres, compared to over 30 acres just three decades ago. This increasing number of forest landowners presents challenges to public agencies as they attempt to help more landowners with fewer staff and reducing budgets. Public managers will have to rely on new approaches and new partners to reach this growing landowner base.

Smaller forested parcels also increase the amount of forest edge and usually increase the chance for the establishment of invasive plants. While the overall impact of invasive species in Delaware’s forests is usually unnoticed, their cumulative effect, particularly in urban forests and forests at the rural/urban interface, is significant and growing.

Issue 4: Many rural and urban forests are not sustainably managed.

Forestry professionals are keenly aware that most private forest landowners do not seek professional forestry assistance (or are not aware of this availability) for managing their woodlands. Furthermore, many landowners only consider their short-term, financial return when selling their timber – even if this option produces a poorly stocked forest. This practice of “high-grading” (harvesting the best timber and leaving the rest) is all too familiar and will not sustain forests – for either their wood products or other resources – for future generations. This situation is compounded in Delaware by the lack of markets for low quality timber (primarily hardwoods).

Urban and community forests face similar challenges. Many cities and towns do not have sufficient expertise or budgets to inventory their street trees and other publicly owned forests or develop a management plan that outlines their long term goals and objectives for

these areas. Often urban forestry budgets are the first to be cut or reduced during difficult economic times. Community leaders and citizens need to understand the importance of forests not only aesthetically but for the numerous environmental benefits they provide (improved water quality and quantity, enhanced recreational experiences, reducing energy costs, reduced stormwater runoff, etc.).

Issue 5: Sufficient financial and technical assistance available to forest landowners (urban and rural).

As with any asset, landowners and communities need professional and affordable assistance for their forests and many landowners do not possess the expertise or experience to manage their forestland. Similarly, urban forests are an important component of cities and towns and many communities do not have forestry professionals on staff to manage these resources. Foresters can help both landowners and communities develop a plan for their forest resources and help them execute that plan. Having access to foresters and arborists helps to ensure that our rural and urban forests are thriving and providing the numerous benefits we all enjoy. Technical assistance not only benefits the forest landowner but also helps to ensure that our forests are sustainably managed for future generations.

Financial assistance is also necessary to help landowners complete forest management practices. Forest management typically produces revenue sporadically and often it is many years, if not decades, between timber harvests – particularly for landowners of small woodlots. Financial assistance, such as cost shares for forest management activities, helps to ensure that landowners can and will complete non-income generating activities, such as timber stand improvement, wildlife habitat enhancement and water quality protection activities. Furthermore, many owners acquire woodlands that have been poorly managed in the past. As these landowners proceed to re-establish sound management practices in their newly acquired woodlands, they often find that the cost of these practices can be quite substantial, depending on the degree of neglect or mismanagement in the past. Funding also benefits cities and towns – often providing the money needed to purchase trees for planting, complete an inventory of the community’s trees, or secure an arborist for pruning and other tree care issues. Financial assistance combined with technical advice is a cornerstone for sound forest management.

Issue 6: Delaware’s diversity.

Despite Delaware’s small size, there is a wide diversity of land use, ideas, and interests within the state. There is an attitude of “downstate versus upstate” for areas south and north of the Chesapeake and Delaware (C&D) Canal. This arose from the urbanized, industrial areas in the north versus the more rural, agronomic economy in the south. This attitude has moderated with the increasing development in the southern part of the state, particularly along coastal areas. Nonetheless, there is still an urban versus rural mentality in many areas of Delaware. The dramatic increase in development has also exposed another somewhat contentious argument in the state. Many Delawareans strongly endorse private property rights; however, the rapid increase in development and suburban sprawl has caused some Delawareans to support tougher land use law and zoning. This conflict is likely to continue into the future. This confrontation also represents another factor in Delaware’s diversity, specifically the increasing number of retirees and others who have recently moved to the state. Many of these relatively new Delawareans are the citizens advocating changes in land use policy that could restrict private property rights. Thus, there are some attitudes of “locals” versus “outsiders.” There are also geographic differences within Delaware, with the Piedmont located in the very northern part of the state and Coastal Plain throughout its

remainder. While all of these attitudes exist, none rise to the level of extreme; in fact, there is often an aversion by Delawareans to confrontation and “making enemies.” Perhaps this is a result of Delaware’s small size – everyone knows everyone else or their friend or relative, so confrontation is avoided. Nonetheless, this diversity provided the foundation for the laws and regulations that govern Delaware’s forests and it will impact any future efforts to revise or develop new policies.

b) **Threats**

1) *Forest Health* - Fragmentation, parcelization, invasive plants, insects, and diseases threaten the long-term health and sustainability of our forests.

As discussed previously, Delaware’s forests – rural and urban – face a wide range of issues that threaten their long-term health. Our forests are increasingly fragmented by development and our remaining forests are divided (parcelized) among more landowners. Six percent of our remaining unprotected forests were included in proposed developments from 2002 to 2009; this trend is not sustainable. Forest fragmentation causes not only forest management challenges, but also produces other effects that are less evident. For instance, it increases the amount of forest “edge” which often leads to the introduction of invasive plants and reduces the habitat for certain interior forest-dwelling species. In addition to the loss of large, contiguous forested areas, there is also a loss of forested corridors (100 to 300 foot wide strips) that connect larger blocks of forestland. These areas provide protected travel corridors for many wildlife species and are often located along waterways, thus providing water quality protection.

Invasive species (plants, insects, and diseases) have also impacted Delaware’s forestlands. Gypsy moth, Dutch elm disease, and chestnut blight are three examples of non-native species that have severely impacted certain tree species within Delaware. While there are no known significant recent introductions of pests to Delaware, there are several located in surrounding states that could potentially impact our forests, such as the Asian longhorned beetle and the emerald ash borer. Invasive plants continue to spread throughout our forests, particularly urban forests and those on the rural/suburban fringe. These plants do not have as dramatic visual impact on our forests as some insects and diseases, but their cumulative impact is significant and often severe.

Additionally, there are native species that are now detrimentally impacting our forests. An overpopulation of white-tailed deer has begun to degrade Delaware’s forests – particularly hardwood forests in northern Delaware. While the Division of Fish and Wildlife has taken several steps to curb this population, there are still portions of the state that have significant overpopulations. This situation is compounded by a decline in the number of hunters in the state. Bacterial leaf scorch (BLS), once considered a relatively minor nuisance for urban forests, is now leading to the death of several red oak species throughout Delaware.

Future efforts must address all of these factors to help ensure the long-term health and viability of Delaware’s forests and help us meet one of the national State and Private Forestry objectives – *Protect Forests from Harm*.

- 2) *Lack of Forest Markets* – markets for traditional forest products (pulpwood and sawtimber) have decreased dramatically in Delaware and the surrounding region and there continues to be a lack of markets for low quality hardwood timber. There is potential for new markets for non-consumptive uses (carbon, wetland mitigation, etc.) but these have yet to develop.

Delaware's landowners need viable and stable markets for their forest products; many landowners will sell or develop their forestland if they cannot generate sufficient income through forest management. The recent economic downturn has further accelerated the decline of traditional forest products markets on the Delmarva Peninsula. The number of sawmills is approximately half of the total from just 15 years ago and this includes the closure of the largest pine sawmill in the region. Pulpwood markets have remained relatively stable but there are only two mills that purchase pulpwood in Delaware and with the continuing decline of the national pulp market, there is the chance that one of these mills could stop purchasing wood in Delaware. Therefore, it is important that Delaware work with its surrounding states to foster new markets, both for traditional products and nontraditional products and services. Bio-energy is a developing market and this could provide new demand for low quality hardwoods. Markets are also emerging for carbon sequestration, wetlands mitigation and even endangered species mitigation and other "ecosystem services" but much work remains to bring them to fruition.

Lack of robust and diverse markets is not only a threat to forest landowners but to our forests. Without markets, we cannot achieve one of the State and Private Forestry national objectives – *Conserving Working Forestlands* or the long-term, sustainable management of our forests.

- 3) *Unsustainable Forest Management* – many of Delaware's urban and rural forests are not sustainably managed. Their owners do not seek (or are unaware of) professional forestry assistance. Markets are not available for low quality trees so they are left behind during timber harvests to seed the next crop; repeated "high grade" harvests eventually leads to a poorly stocked forest with no high-quality trees for future harvests. Many cities and towns do not have the expertise or the funds to retain forestry experts to manage their urban forests and incorporate urban forestry concepts into land use planning. All of these factors, combined with forest loss and fragmentation, contribute to unsustainable management of our forests, which affects the ability of our forests to provide the wide range of benefits that we all enjoy and require to sustain our quality of life. Without sustainable management, we cannot meet the national S&PF objectives to *Enhance Public Benefits from Trees and Forests* and *Conserve Working Forestlands*.

Fortunately, the percentage of Delaware's forests that are not well managed is decreasing. Efforts to educate communities, landowners, and forestry operators (loggers, equipment operators, timber buyers, etc.) about forest and forest management are making an impact. Programs to inform the general public about forest management are also increasing. However, there is room for improvement. Future efforts by the DFS and other natural resource agencies should explore methods to reach more landowners and communities while confronted with decreasing budgets and staffing. Additionally, addressing another threat – lack of forest markets – will help to combat this threat; having diverse and stable markets for forest products and services will help landowners

keep their forests as forests. Maintaining a critical mass of forestland – rural and urban – and working to ensure they are sustainably managed for a variety of benefits is vital to our quality of life.

c) **Opportunities**

- 1) *Increase public awareness and understanding of the importance and need for forests and forest management through education of both children and adults.*

In order to protect and sustain our forest resources, the public must understand and value the importance of these resources. This process starts with educating our citizens, not just forest landowners and forest operators (e.g., loggers, timber buyers) but community leaders, land use planners, legislators, educators, forest users – everyone. Reaching the entire public is a difficult task, so a strategic, prioritized approach is necessary. Some examples include:

- **Children:** Incorporate environmental education into curriculum, such as through Project Learning Tree (PLT). Encourage outdoor classrooms at schools and assist with incorporating these classrooms into the schools' curriculum, such as tree planting projects, monitoring water quality, etc. Also, investigate the possibility of required classes for students in natural resources studies.
- **Adults:** Provide educational opportunities – both in the classroom and on the Internet – for a variety of forestry issues including: forest management, intergenerational transfer, and tax information. Similarly, develop urban forestry-based educational programs for community leaders, civic associations, and homeowners on topics such as tree care, incorporating trees into land use planning, environmental benefits of urban forests, etc.

- 2) *Protect a sufficient forest base to ensure the perpetual production of forestry outputs – timber, wildlife habitat (including rare & endangered species habitat), recreational opportunities, water quality protection, etc., as well as a representation of the various forest types found in Delaware.*

Forests provide a plethora of environmental and economic benefits and it is crucial that Delaware maintain a sufficient amount of forestland to perpetuate these benefits. A full representation of the various forest types (cypress swamps, pine forests, bottomland hardwoods, etc.) is needed to provide the habitat necessary for various plant and animal species. This process could also identify forests that are important for environmental values – such as wetlands, riparian forests, wildlife habitat, etc. – and for timber production (working forests). Additionally, it would identify where strategic afforestation could provide significant environmental benefits, such as connecting forested blocks, creating and expanding forested corridors, buffering headwaters of an important waterway, etc. Communities also need adequate urban tree cover to provide quality of life and environmental benefits; municipalities and community groups should set urban tree canopy goals and consider prioritizing tree planting where it will provide multiple benefits – such as improving water quality. Some opportunities to achieve these objectives include:

- Work with other natural resource agencies, landowners, the forest industry, etc., to develop goals for forestland protection and conservation in Delaware, such as the identification of protection strategies for Delaware's various forest types and riparian forests protection and enhancement, and the control of invasive species (plants, insects, and disease) and white-tailed deer.
- Maintain and increase funding – public and private – for conserving priority forestlands through conservation easements, and in high-priority cases, fee simple purchases. These programs should protect both working forestlands and forests targeted for their high environmental values.
- Enhance incentives for landowners to maintain their forestland – such as property tax reductions, payments to protect the high priority forests, etc., and establish forestland to achieve high priority environmental benefits.
- Incorporate forests and forest benefits into land-use planning processes to help decrease the rate of forest fragmentation in the state.
- Incorporate urban tree canopy goals into municipal plans. Work with municipalities and community groups to set urban tree canopy goals and identify priority areas for maintaining and expanding urban forests.

3) *Maintain adequate and diverse forest markets for landowners to earn a satisfying return on their investment.*

Most forest landowners must earn income from their forestland, or have the potential to earn income, if they are to retain their forests as forests. A stable, robust forest market is vital to the long-term sustainability of forestry and forestland. To that end, there are opportunities to help sustain and expand forest markets:

- Improve and refine the state's forest inventory by working with the U.S. Forest Service and other partners to develop better acreage estimates of the various forest types/species (loblolly pine, baldcypress/Atlantic white-cedar, red and white oak, etc.) and the amount of wood available for various markets – such as low quality hardwoods for bio-energy.
- Work with Delaware's existing wood processors to help ensure their long term profitability.
- Promote and facilitate new markets for wood products – such as bio-energy – and ensure these markets are properly sized for the supply available (including working with forestry agencies of adjoining states).
- Promote and facilitate non-consumptive forest markets – such as carbon credits for forest management and urban forests (not just afforestation), endangered species bank, and wetland mitigation banks – commonly called ecosystem services.

4) *Sustainably manage Delaware's rural and urban forests.*

Ultimately, we must not only maintain sufficient forest acreage but also sustainably manage those rural and urban forests if current and present Delawareans are to enjoy all of the many benefits we receive from forests. Furthermore, most of these forests will be privately owned (or in the case of urban forests owned by homeowners or communities); therefore, these landowners must have the knowledge and ability to manage their forests so that we all benefit. We must seize the opportunities we have to achieve this goal, including:

- Provide technical forestry assistance to landowners, homeowners, and communities through multiple avenues (Internet, group sessions, train-the-trainer, site visits, etc.); this assistance should also address land transfer/estate planning.
- Work with other organizations (public and private) to maintain and enhance cost-share and incentive payment programs, particularly for landowners to conduct high-priority forestry activities and forest management activities in high-priority focus areas.
- Develop other incentives to help conserve and expand forests – such as tax incentives, etc.
- Maintain, encourage and foster new markets for forest products and services.
- Ensure volunteer fire companies are well trained and prepared for wildland firefighting.
- Continue to monitor for forest pests – native and non-native – and prepare for the arrival of new pests.

Rural Priority Landscape Areas

1. OVERVIEW

The Farm Bill¹ requires each state to complete a Statewide Forest Resource Assessment or “State Assessment” and Statewide Forest Resource Strategy or “Resource Strategy” to receive funds under the Cooperative Forestry Assistance Act. State Assessments are intended to identify key forest-related issues and priorities to support development of the long-term Resource Strategy. All States are required to complete a State Assessments and Strategies document by June 2010. A primary goal of this process will be to prioritize the allocation of Federal funds in the future.

In order to complete the prioritization process, Geographic Information System (GIS) technology was used. GIS is sophisticated computer software that allows complex analysis of geographic data on standard desktop computers. The Delaware Forest Service (DFS) has routinely used GIS technology since 2000 for a variety of purposes, and all DFS foresters have been capable GIS users since 2005. Therefore, DFS was pre-positioned to carry out this complex analysis without additional software or training.

The GIS analysis used for this study involved the overlay of 23 layers of data. Some layers were recommended by U.S. Forest Service (USFS) guidelines. Other layers were added by DFS staff because they were clearly relevant in Delaware. A few additional layers were incorporated based on recommendations made by members of the Forest Stewardship Committee in 2009.

This analysis was used to identify the critical forested landscapes in rural areas; another analysis identified the critical urban forests. Therefore, this process only included forest and agricultural lands (as recommended by the USFS because agricultural land can be converted to forestland) and land located outside of municipal boundaries.

Once the 23 input layers were assembled, they were combined in an overlay process. A composite score was calculated for each 30 meter by 30 meter area in the State (representing about a quarter of an acre) based on the presence or absence of each of the input layers for that area. Layers were weighted according to average scoring of Committee members, so that higher-scoring layers were given more weighting in the composite score.

For those familiar with the 2006 Spatial Analysis Project (SAP), this analysis followed the same general guidelines. However, there were some important differences between the SAP analysis and this one:

1. Unlike SAP, this analysis included public lands.
2. This overlay process incorporated almost twice as many layers as SAP to compute priority scores.
3. SAP did not include urban areas. Urban areas are included in this analysis, though the input layers and ranking system were different.

The 23 data layers included in the State Assessment GIS analysis included the following (presented in order of their weighting for the GIS analysis):

¹ The Food, Conservation, and Energy Act of 2008, commonly referred to as the Farm Bill, was enacted June 19, 2008.

1. SAP High Priority Areas
2. Forest Fragmentation
3. State Wildlife Action Plan/Threatened and Endangered Species
4. Riparian Areas
5. Conservation Easements
6. Forest Legacy Areas
7. Forest Cover
8. Tree Farms
9. Commercial Forest Plantation Act (CFPA) Properties
10. Forest Health Risk
11. Low Development Risk
12. Protected Lands
13. High-Priority Watersheds
14. Natural Areas
15. Green Infrastructure
16. Landowner Incentive Program (LIP) Parcels
17. Groundwater Recharge/Drinking Water
18. High Productivity Soils
19. Existing Mills
20. Wildfire Risk
21. Wildland/Urban Interface (WUI)
22. Impaired Air Quality
23. Historical/Cultural Sites

Additional layers recommended by the USFS or the Stewardship Committee that were not incorporated into the analysis included the following:

<u>Layer</u>	<u>Reason for not Using</u>
Population Density	Redundant with Wildland/Urban Interface
CREP	Not available
Wetlands Reserve Program	Not available
Urban Heat Islands	Very low ranking by Committee
Trails	Very low ranking by Committee, difficult to model
Nature Preserves	Subset of Easements layer, would lead to double-counting

2. INPUT LAYERS

Following is a more detailed description of each of the 23 input layers.

1. SAP High Priority Areas

The final SAP (Stewardship Analysis Project) High Priority Areas layer from the 2006 SAP analysis was used. This layer was developed as part of a nationwide process administered by the U.S. Forest Service to identify the privately owned forests that were the highest priority for technical assistance through the Forest Stewardship Program. These areas were identified through a GIS process that included: private forestlands, priority watersheds, public water supplies, riparian buffers, threatened and endangered species, wildfire risk, proximity to public lands (less than ¼ mile), forest patches (greater than 10 acres), forest health, green infrastructure, wildfire risk, developing areas, and forested wetlands. This data layer provided an excellent analysis of the important privately owned forestlands.

2. Forest Fragmentation

A layer was developed by DFS to represent contiguous forested areas that cover **at least 250 acres**. Unlike some pre-existing datasets, the one used in this analysis does not consider a forest block to be contiguous if it is bisected by a paved road. Instead, forest areas on either side of roads were considered separate blocks for acreage determination. While relatively small for some areas of the country, a 250-acre contiguous forested area is significant in Delaware. Large areas of contiguous forest are important for a variety of reasons, including habitat for forest-interior dwelling species; large forested areas also usually present more opportunities for forest management.

3. State Wildlife Action Plan/Threatened and Endangered Species

The input layer was provided by Delaware's Natural Heritage Program. It represents rare species (S1, S2, Threatened, and Endangered) and Habitats of Conservation Concern as identified in the Delaware Wildlife Action Plan. State assessments are required to incorporate information from state wildlife action plans and this data layer captures the habitat information for Delaware's most threatened species.

4. Riparian Areas

Riparian forested buffers improve water quality by filtering sediments and other pollutants before they reach streams and other waterways. These forests also moderate stream water temperatures and provide travel corridors and other habitat for many wildlife species. The DFS created a riparian areas layer by buffering the GIS layers for statewide stream and water bodies by 100 feet. This buffering function created riparian areas that are 200 feet wide.

5. Conservation Easements

Conservation easements permanently protect land from development; therefore, it is likely that forests under conservation easements will remain forested. In some circumstances, it is worthwhile to target technical and financial assistance to these areas because there is little danger of a change in land use. This input layer includes the following:

1. Easements held by DFS (including Forest Legacy Easements)
2. Easements held by DNREC Parks & Recreation
3. Delaware Aglands Preservation Foundation Easements
4. Delaware Forestland Preservation Program Easements

6. Forest Legacy Areas

This layer contains Delaware's four Forest Legacy Areas that were approved by the Secretary of Agriculture in 1998 as well as all subsequent revisions approved by the U.S. Forest Service. These are the areas where Delaware can use USDA Forest Legacy funds to protect working forestlands and were identified as high priority areas in Delaware's Forest Legacy Assessment of Need. Forest Legacy Areas are to be incorporated into the State Assessment as stipulated by USFS guidelines.

7. Forest Cover

Forest cover is obviously an important component of a state forest assessment; one should know the extent and location of the state's forestland. DFS staff developed this dataset from 2007 data. This layer is the most accurate one available and, unlike other layers developed by state agencies, includes young loblolly pine plantations (previous forest cover layers have often classified young pine plantations and seedling/sapling forests as "brush").

U.S. Forest Service staff recommended including forest and agricultural lands in the overlay process because croplands can be converted to forest (afforested). Therefore, agricultural lands are not excluded from the overlay; however, existing forest cover, as represented by this layer, received higher weighting.

8. Tree Farms

The DFS created this layer and it represents the forests currently enrolled in the Tree Farm program administered by the American Forest Foundation. Tree Farm properties are typically some of the most well-managed, privately owned forests, not only for timber production but for other benefits as well (wildlife habitat, water quality, etc.). Furthermore, these lands are usually more likely to remain forested because their owners have shown a vested interest in their forestland.

9. CFPA Properties

This data layer, created by the DFS, contains the forestland enrolled in Delaware's Commercial Forest Plantation Act (CFPA). This act provides a 30-year property tax exemption for privately owned forests at least 10 acres in size and that are managed for timber production following a forest management plan approved by the DFS. These properties are also typically well-managed and are more likely to remain forested, which is important information for the state assessment.

10. Forest Health Risk

Forest health, and the potential for future threats to forest health, is vital to understanding the condition of Delaware's forests and helps to guide future forest management decisions; this layer, provided by the U.S. Forest Service, helps to assess forest health. It is based on Forest Inventory and Analysis (FIA) data and predicts the amount of mortality through basal area loss (a measure of forest stocking) due to forest insects and diseases over the next ten years at a one-kilometer scale. Because most of Delaware has an estimated future loss of zero, areas with estimated loss **greater than zero** were used as the forest health risk input.

11. Low Development Risk

Loss of forestland to development is unavoidable. Future investments in forest conservation and forest management are usually more worthwhile in areas not targeted for development by state and local governments because these areas will not have the infrastructure (better roads, central sewer and water, etc.) necessary to support widespread, dense development. Delaware has identified four levels for state investment; Levels 1 to 3 include existing urban areas and those rural-urban fringe

areas targeted for development in the future. Level 4, which is most of the state, are the rural areas where no state-supported infrastructure improvements are planned and, thus, population growth is not desired. This data layer contains the Level 4 layer within Delaware's existing State Strategies dataset.

12. Protected Lands

This input contains all properties owned in fee simple (no easements) by federal, state, county, and local governments as well as nongovernmental organizations with natural resource protection missions. This data layer attempts to capture public and NGO lands because these properties are likely to remain undeveloped. These properties often serve as the "core" areas for forest protection efforts. Expanding these core areas with additional purchases, easements on adjoining private lands, etc. can help maintain, expand, and connect large patches of forests. Knowing the location of these parcels can help guide future forest conservation efforts and investments. The ownerships included in this layer are:

1. State Parks
2. State Fish & Wildlife lands
3. Federal Fish & Wildlife lands
4. State Forests
5. Stockley Center
6. Non-Governmental Organization (NGO) lands
 - a. Mt. Cuba Center, Inc.
 - b. The Nature Conservancy
 - c. Delaware Nature Society
 - d. Delaware Wild Lands, Inc.
 - e. Nanticoke River Watershed Alliance
7. Dover Air Force Base
8. Hoopes Reservoir parcels owned by the City of Wilmington
9. National Guard properties
10. County Parks
11. Other County-owned lands
12. DelDOT properties
13. Community Open Space properties, where available

13. High-Priority Watersheds

Clean water is a priority for all citizens. Unfortunately, many of Delaware's waterbodies do not meet the EPA definition of swimmable and fishable. Forests and forest management can help improve water quality, such as through the establishment of riparian forested buffers. The Delaware Nutrient Management Program, using data supplied by DNREC, Division of Water Resources, classified Delaware's watersheds as high, medium, or low priority for water quality improvement. The high priority watersheds were used for this data layer.

14. Natural Areas

Many of the most ecologically diverse habitats are found in forests. Conserving and protecting these areas is important to ensure that the plant and animal species found in these habitats continue to thrive. Delaware law (Title 7, Chapter 73) establishes a process to identify Natural Areas – those tracts that contain the best examples of diverse flora and fauna. This data layer contains Delaware's identified Natural Areas.

15. Green Infrastructure

As a corollary to efforts targeting development to certain areas by focusing future spending on “gray” infrastructure (roads, sewer, schools, etc.), states also attempt to target conservation efforts by focused spending on “green” infrastructure (land purchases, conservation easements, etc.). Delaware’s previous governor, Governor Minner, led an effort to identify the most important forest and natural resource lands as a strategy to focus future conservation efforts and spending. Including these areas in the state assessment for rural forests helps to analyze where the state has targeted future land conservation efforts. This data source is the existing Green Infrastructure data subsets for working forests and natural resources.

16. Landowner Incentive Program (LIP) Parcels

Landowners who receive cost shares for forest management usually retain their forests; these forests are also usually well-managed – not only for wood production but also other benefits such as wildlife habitat, water quality, etc. Thus, including forestlands that have received cost share payments is a valuable component of the state forest assessment. Delaware’s Forest Stewardship Committee recommended including forestland and agricultural land planted with trees enrolled in the Wetlands Reserve Program (WRP), Conservation Reserve Enhancement Program (CREP), and Delaware’s Landowner Incentives Program (LIP). Unfortunately, only LIP properties were mapped; therefore, this layer contains the LIP reforestation areas provided by State Fish & Wildlife staff. (This map is not included because the 90 acres of LIP properties are not visible at the statewide scale.)

17. Groundwater Recharge/Drinking Water

Groundwater is the primary source for drinking water in Delaware. Forestland is widely recognized as providing clean, abundant water. Therefore, protecting the state’s highest-quality forested groundwater areas is an important long-term strategy. This dataset contains the groundwater recharge areas classified as excellent by the Delaware Division of Water Resources.

18. High Productivity Soils

Soil and water are essential for forests. Therefore, an assessment of a state’s soils is an important component of a forest assessment because one may wish to consider soil quality when focusing forest conservation efforts. The DFS developed a High Productivity soils layer using the USDA NRCS county soil surveys (please note that the soil surveys published in the 1970s were used, NRCS recently updated its soil survey; future analyses will use the updated data). High productivity soils were defined as:

1. For Kent and Sussex Counties, soils capable of producing **loblolly pine** annual growth increments of 320 board-feet per acre, per year, at age 50. This includes Evesboro loamy sand (but not Evesboro sand), Fallsington, Kalmia, Matawan, Pocomoke, Sassafra, and Woodstown soils.
2. For New Castle County, soils capable of producing **yellow-poplar** annual growth increments of at least 300 board-feet per acre, per year, at age 50. Included are Bayboro, Butlertown, Codorus, Delanco, Evesboro, Fallsington, Hatboro, Johnston, Klej, Matapeake, Mixed alluvial, Rumford, Sassafra, and Woodstown soils.

19. Existing Mills

Access to stable and diverse forest markets is an important and necessary tactic to keep private forestlands as forests. Without viable markets to generate income, many forest landowners will convert their forests to other uses. Traditional forest markets, such as primary wood processors (sawmills, paper mills, plywood mills, etc.), are a major component of forest markets. DFS staff

created a dataset that mapped sawmills, log concentration yards, and chip mills in the area. The Forest Stewardship Committee originally recommended a 20 to 30 mile buffer around these facilities to represent the “zones” within which logs could be delivered at very low hauling costs. However, even the 20-mile buffer included the entire state and any data layer that includes the entire state has no effect on the analysis. Therefore, these mills were buffered with 10-mile radii.

Please note that three facilities in Maryland were included because their 10-mile buffers extended into Delaware.

20. Wildfire Risk

Wildfires can pose a substantial risk to forest health; knowing areas that are most prone to high-intensity wildfires can help foresters better plan for and mitigate this threat. While Delaware does not often experience intense wildfires, there are two cover types that are susceptible to incendiary fires – young loblolly pine plantations and areas dominated by the invasive reed, *Phragmites australis* (Fuel Model 3). DFS developed layers for each of these cover types and combined them to map wildfire risk.

21. Wildland/Urban Interface (WUI)

The wildland/urban interface demonstrates where urban areas are expanding. Therefore, it is likely that forests and other undeveloped lands in these areas will soon be impacted and/or replaced by development. Identifying these areas is important to a forest assessment as it can help focus where to (and where not to) spend limited public funds on forestry projects. Census data was used to derive a layer representing census blocks with medium density housing, with medium density defined as 50 to 640 houses per square mile (average lot size between 1 acre and 13 acres).

22. Impaired Air Quality

Air quality is important for all life – plant and animal. Forests can improve air quality by helping to remove particulates and other pollutants; therefore, governments may wish to target forest conservation efforts in areas with poor air quality. A 2007 air quality report published by DNREC Air Quality Management reported the following:

1. While all three counties had exceedances of ozone standards in 2007 (the most recent year for which data were available), New Castle County had more violations than the other counties.
2. New Castle County failed to meet PM_{2.5} standards during every year from 2001 through 2007. Kent and Sussex Counties did not have any PM_{2.5} violations during this time period.

Based on these findings by Delaware’s air quality management agency, the boundary of New Castle County was used to map Delaware’s poor air quality area.

23. Historical/Cultural Sites

Historical and cultural sites are important to a state’s history and recreational economy. Protecting and buffering these sites from land use conversion is an effective method to ensure their preservation. The DNREC Historical & Cultural Affairs staff provided a data layer representing Delaware’s 679 sites listed in the National Register. The DFS staff established a ½-mile radius around each site to represent a buffer. Forest cover around these sites can maintain and enhance their aesthetic value and provide other economic and environmental benefits (wildlife habitat, riparian buffers, etc.).

3. OVERLAY METHODOLOGY

Each input layer was converted to a raster dataset (pixels). A resolution of 30 meters was chosen as a compromise between limitations of existing data resolution and the desired high-resolution final product. This resolution is approximately equal to quarter-acre resolution, meaning there are about five million pixels in the State.

All layers were “**clipped**” to a statewide layer consisting of forest cover and cropland, not including forest and cropland within municipal boundaries. This means that any land uses other than cropland or forest, and any lands of any type within municipal boundaries, were not included in the model. We included cropland because agricultural land can be converted to forest via planting or abandonment. We did not include municipal areas because a separate (and different) analysis was conducted for urban areas.

The following weighting scheme, based on the votes of the Committee members present at the May, 2009 meeting, was utilized:

<u>Input Layer</u>	<u>Committee Value</u>	<u>GIS Weighting</u>
SAP High Priority Areas	4.5	1.2
Forest Fragmentation	4.5	1.2
SWAP/T&E Species	4.4	1.2
Riparian Areas	4.3	1.2
Conservation Easements	4.3	1.2
Forest Legacy	4.3	1.2
Forest Cover	4.2	1.1
Tree Farms	4.1	1.1
CFPA	4.1	1.1
Forest Health Risk	4.1	1.1
Low Development Risk	4.1	1.1
Protected Lands	3.9	1.1
High-Priority Watersheds	3.8	1.0
Natural Areas	---	1.0
Green Infrastructure	---	1.0
LIP Parcels	3.7	1.0
Groundwater Recharge	3.5	1.0
High Productivity Soils	3.5	0.9
Existing Mills	3.3	0.9
Wildfire Risk	3.2	0.9
Wildland/Urban Interface	2.5	0.7
Impaired Air Quality	2.5	0.7
Historical/Cultural Sites	2.3	0.6

For each pixel, all of the input layers present were included in the final score for that pixel. In other words, if an input layer was present for a given pixel, then the pixel received the weighted value for that layer. The overlay process used a simple “present/not present” process to determine whether the value for that layer would be included in the composite score. Consider the following example from a single pixel near Georgetown in Redden State Forest:

<u>Input Layer</u>	<u>Present in this Pixel</u>	<u>Weight in Final Score</u>
1. SAP High Priority Areas	no	0
2. Forest Fragmentation	yes	1.2

3. SWAP/T&E Species	yes	1.2
4. Riparian Areas	no	0
5. Conservation Easements	no	0
6. Forest Legacy Areas	yes	1.2
7. Forest Cover	yes	1.1
8. Tree Farms	no	0
9. CFPA	no	0
10. Forest Health Risk	yes	1.1
11. Low Development Risk	yes	1.1
12. Protected Lands	yes	1.1
13. High-Priority Watersheds	yes	1.0
14. Natural Areas	yes	1.0
15. Green Infrastructure	yes	1.0
16. LIP Parcels	no	0
17. Groundwater Recharge	no	0
18. High Productivity Soils	yes	0.9
19. Existing Mills	yes	0.9
20. Wildfire Risk	yes	0.9
21. Wildland/Urban Interface	no	0
22. Impaired Air Quality	no	0
23. Historical/Cultural Sites	no	0

Composite score for this pixel	13.7
--------------------------------	------

A map was then created to display the results of the overlay with color-coding for final composite scores. “Natural breaks” in the data were used to divide the scores into the following three classes:

<u>Priority Class</u>	<u>Composite Score Range</u>
Low	0 – 5.29
Medium	5.3 – 9.0
High	9.01 +




None of the 3.8 million pixels in the study area received a composite score higher than 18.5.

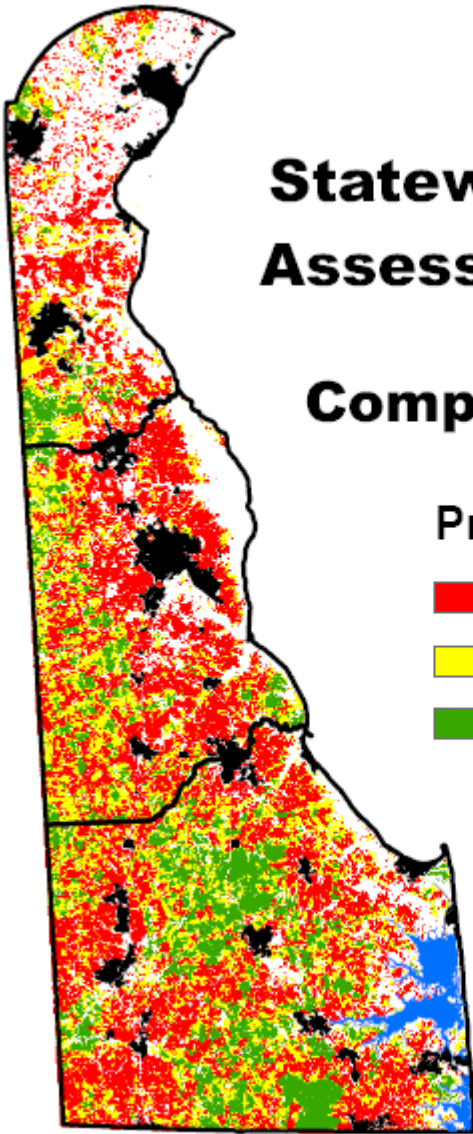
4. COMPOSITE MAP: RURAL FORESTS

Statewide Forest Assessment 2009

Composite Map

Priority

-  Low
-  Medium
-  High



Urban Priority Landscape Areas

Prioritized Urban Communities

1. OVERVIEW

Like many states, Delaware has experienced tremendous growth over the last decade. During that time, previously unincorporated rural areas have been annexed and subsequently developed by many communities throughout the state. While this creates new opportunities for urban forestry, this growth also adds pressure on the urban forest resource. Only until the recent recession has this growth subsided. As funding for urban forestry has increasingly becomes scarce it is evident that a prioritization of communities was necessary in order to increase the efficacy of the Delaware Urban and Community Forestry (U&CF) Program.

Therefore, all 57 incorporated municipalities were evaluated using a Geographic Information System (GIS). The model for analysis was simply a formula that weighted each community according to four (4) criteria and formula listed below:

1. Percentage of Urban Tree Canopy (25%)
2. Percentage of impervious surface (25%)
3. Percentage of fire risk in the wildland urban interface. (15%)
4. Population density (35%)

$$UCF_{index} = 25 \left(1 - \frac{TC_i - TC_{min}}{TC_{max} - TC_{min}} \right) + 25 \left(\frac{IMP_i - IMP_{min}}{IMP_{max} - IMP_{min}} \right) + 35 \left(\frac{PD_i - PD_{min}}{PD_{max} - PD_{min}} \right) + 15 \left(\frac{FR_i - FR_{min}}{FR_{max} - FR_{min}} \right)$$

The analysis was done in three asynchronous stages over a twelve month period. The first step was the creation of the municipal UTC layer. Step two was the creation of the fire risk layer. The final step was the calculation of percentages of UTC, impervious surfaces, and fire risk in a spreadsheet program. The result of the analysis yielded an indexed list of all 57 communities in Delaware Ranging from zero (0) to one-hundred (100). Higher ranking indicates higher priority for U&CF program delivery. This indexed list was spatially joined to the map of municipal areas within the GIS to indicate where the priority areas were located. Based on natural breaks in the data, the indexed list of communities was displayed according to five (5) classes ranging from very low to very high priority.

2. INPUT LAYERS

The data for the urban analysis is described in detail below:

1. Urban Tree Canopy (UTC)

The UTC layer was developed for all municipal areas as of calendar year 2008. The source data for the project was from a 2007 aerial survey of Delaware by which Light Detection and Ranging (LiDAR) data was generated. LiDAR data is useful in determining heights of objects on the ground as a laser is emitted from the sensor head mounted on the aircraft from which it

is flown. Multiple returns may be received as the beam returns to the sensor head. This is useful as varying heights indicate different types of vegetation used in the UTC analysis. Before the LiDAR data could be used, it was converted in to GIS friendly shapefile format. It was determined that only returns 3 and 4 were likely trees, so these returns were selected and the rest discarded.

Once the correct LiDAR points were in place they were clipped to the boundaries of the municipal areas and broken into smaller more easily managed sections for larger communities. Next the points were edited to erase errant points not eliminated by querying. For example, powerlines frequently were displayed which needed to be removed. In addition, points were added to account for evergreen trees that were eliminated from the original dataset.

Once the points were edited, they were buffered by 3 meters to account for leaves as the data was captured during leaf. Since the final shapefile for each community still had millions of points, it was converted to a 3 meter raster format for area calculation. The data was then used to calculate the percentage of UTC for each municipality.

2. Impervious Surface

The impervious surface data was developed from LiDAR data that was flown in 2007. This existing dataset was simply clipped to municipal bounds and used to calculate the percentage of each community that was impervious

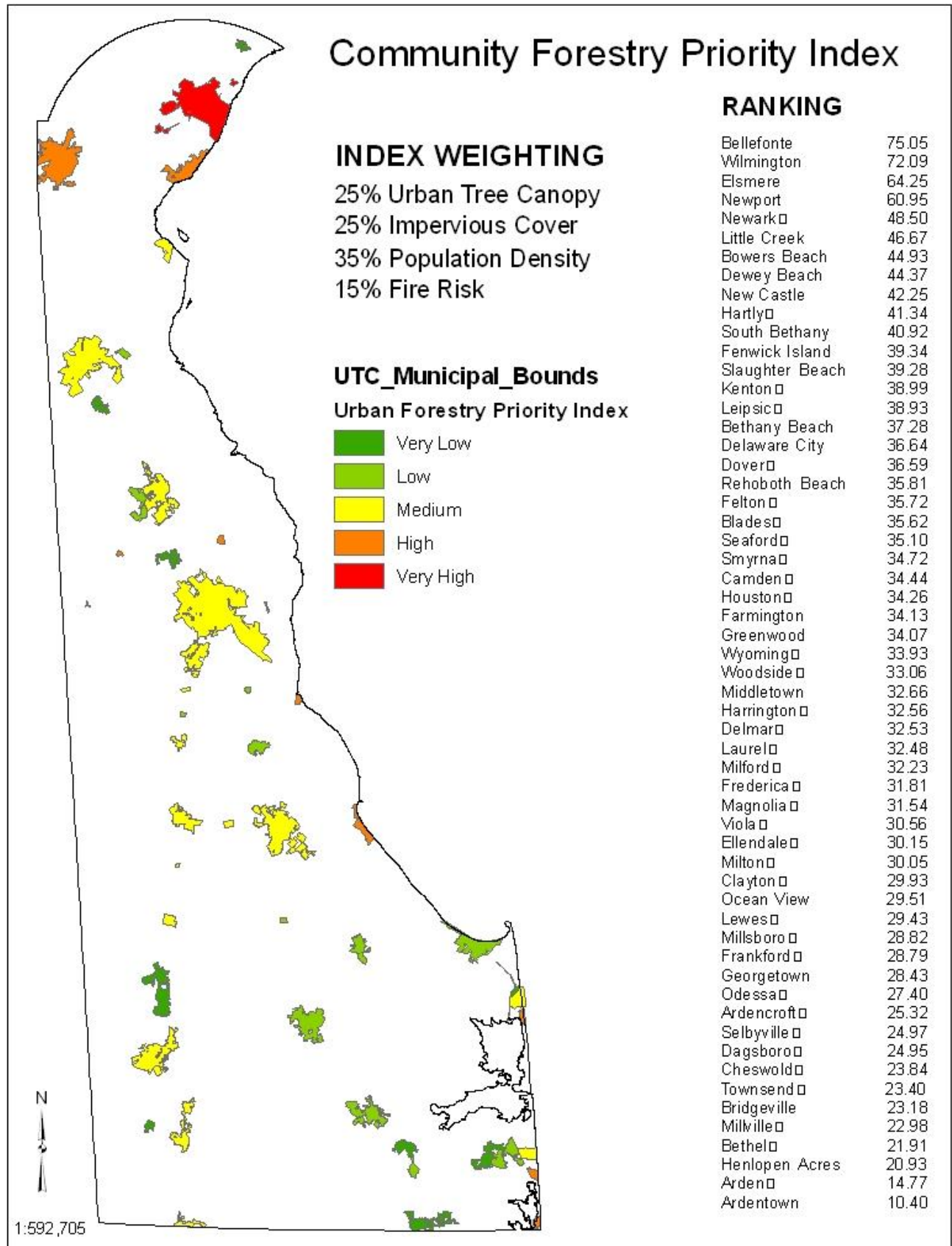
3. Fire Risk

The fire risk dataset was developed by the Delaware Forest Service (DFS) to quantify and spatially locate areas that posed the greatest risk of wildfire in Delaware. Plume dominated fires in Delaware are usually located in two fuel types. One fuel type is young pine stands ranging from 5 to 30 feet in height. The other fuel type is phragmites or common reed grass that dominates marshland and other wet low lying areas in the state. Using the 2007 high resolution aerial imagery those areas that were young pine plantations and Phragmites were digitized manually and occasionally when needed spot checked to ensure quality. The two layers were aggregated to form the final fire risk layer. The percentage of fire risk for each community was calculated.

4. Population Density

The population density was simply calculated by taking the population of each community (2000 Census) and dividing it by the number of square miles of area of each community. This data was used as a means to evaluate the demands placed on the urban forest resources for each community.

3. COMPOSITE MAP: URBAN FORESTS



8. *Summary (to be added)*

9. *Appendices (to be added)*

- a) References
- b) Methodology for Geospatial Analysis
- c) Data Gaps (if any)